

# PRO V&V



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## Test Report for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.2 Voting System

EAC Project Number: UNS10121966-2.2

Version: 03

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U.S. Election Assistance Commission

# VSTL

EAC Lab Code 1501

# NVLAP<sup>®</sup>

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**REVISIONS**

<b>Revision</b>	<b>Description</b>	<b>Date</b>
00	Initial Release	09/20/2021
01	Expanded Section 1.0 Introduction to include Test Plan information	09/20/2021
02	Updates per EAC Comments. Corrected Hardware Test Report reference. Reformatted as needed.	10/07/2021
03	Corrected Typos in section 2.2.3. Updated a document version in Table 3-1.	10/29/2021

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## 1.0 INTRODUCTION

The purpose of this Test Report is to document the procedures that Pro V&V, Inc. followed to perform certification testing during a system modification campaign for the Unisyn Voting Solutions OpenElect Voting System (OVS) Version 2.2 to the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Certification testing of the OVS Version 2.2 Voting System submitted for evaluation was performed to ensure the applicable requirements of the EAC 2005 VVSG and the EAC Testing and Certification Program Manual, Version 2.0, were met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test were incorporated in the test campaign.

Prior to submitting the voting system for testing, Unisyn submitted an application package to the EAC for certification of the OpenElect 2.2 Voting System. The application was accepted by the EAC and the project was assigned the unique Project Number of UNS10121966-2.2.

*The OVS 2.2 EAC-approved test plan, as published on the EAC's website at [www.eac.gov](http://www.eac.gov), was utilized as the guiding document during test performance. Since test plan approval, and as testing progressed, minor system modifications, such as revised system documentation, were incorporated. This test report reflects all of the testing completed and details the final versions of all technical documentation and system components and supersedes the approved test plan.*

### 1.1 Description and Overview of EAC Certified System Being Modified

The OVS 2.2 system is a modification to the previously EAC-certified OVS 2.1 Voting System. A detailed description of the OVS 2.1 test campaign is contained in Pro V&V Report No. TR-01-01-UNI-005-01.02, which is available for viewing on the EAC's website at [www.eac.gov](http://www.eac.gov).

*The EAC Certified System that is the baseline for the submitted modification is described in the following subsections. All information presented was derived from the previous Certification Test Report, the EAC Certificate of Conformance and/or the System Overview.*

OVS 2.1 is a paper ballot voting system using touch screen and scan technology to scan and validate ballots, provide voter assisted ballots to accommodate voters with special needs, and tabulate results. OVS 2.1 consists of the following major components:

- **OpenElect Central Suite (OCS)**
- **OpenElect Voting Optical (OVO)**
- **OpenElect Voting Interface – Vote Center (OVI-VC)**
- **FreedomVote Tablet (FVT)**
- **OpenElect Voting Central Scan (OVCS)**

The OVO, FVT, and OVI-VC are the OVS components designed to accept voter input. The FVT and OVI-VC are the OVS ballot marking devices (BMDs). The OVO can collect and tally

precinct votes, generate reports, and store election data internally. The OVCS is the bulk scanner used for mail-in ballots, provisional ballots, and recounts

A list of the baselined OVS 2.1 components and associated descriptions, as taken from the Unisyn technical documentation, is provided below.

- **OpenElect Central Suite (OCS)** – the software suite installed on an Election Center PC that is capable of configuring the ballot, setting elections parameters, scanning, tallying, auditing and creating election reports. The Election Management System (EMS) consists of the following components running as either a front-end/client application or as a back-end/server application:
  - **Ballot Layout Manager (BLM)** - uses a database to create and store precinct and district information and an interface to create, check, translate, and produce the ballot styles needed by a jurisdiction for an Election. The BLM output is printer ready artwork of all ballots in all languages and the Unisyn election definition file in an encrypted XML file format.
  - **Election Manager (EM)** - converts data from the BLM's encrypted XML file to a Unisyn specific format and adds jurisdiction defined election options. It then prepares compressed, encrypted election files for output to a USB Drive, creating the "Election USB TM." The EM also creates and manages Supervisor and Maintenance technician logins and passwords. The EM produces compressed, encrypted election files which are saved to the Election USB TM to load the election files onto the OVO and OVDs for voting. These encrypted election files are also used by the post-election OVS components for Post-Election Day processing.
  - **Tabulator Client (TC)** - after an election, the TMs from the OVO's at each poll location are delivered to a central count location. The TC retrieves vote files and ballot images from the TM devices and stores them on its hard drive. When prompted, it will transfer the files to the Tabulator for tally. The TC can reside on the same PC as the Tabulator or on a PC that communicates with the Tabulator.
  - **Tabulator** - receives and validates uploaded voting data, and provides a status of uploaded files as well as handling RCV functionality. It also updates the database with adjudicated ballots from the Auditor application. The Tabulator maintains the Tabulator database, which stores the results from all precincts.
  - **Auditor** - accesses ballot images and data from the OVCS and Tabulator Client PCs to allow jurisdiction personnel to evaluate and update questionable or erroneous marks on a ballot in accordance to the voter's perceived intent. The Auditor can also be used to process write-ins on both full page and BMD Ballots. All changes are uploaded to the Tabulator database and actions are password controlled.

- **Tabulator Reports (TR)** - accesses data from the Tabulator database to generate the necessary election reports.
- **OpenElect Voting Optical (OVO)** – is a full-page dual-sided optical scan system that scans and validates voter ballot pages and provides a summary of all cast ballot pages.
  - **Personal Computer (PC)** – The computer component (with a seven inch touch panel display) has pre-installed software that provides a user interface for voting and maintenance. Election files generated by the EM are loaded manually via a USB TM. The election files also set passwords, parameters and ballot styles for that election. (Valid ballots for a poll location are initialized on Election Day startup by scanning a ballot header card.)
  - **Transport Media (TM)** – The transport media is a 1 GB or larger USB flash drive that provides the means of transporting audit logs, scanned ballot page images and vote files from the precinct on Election Night to Election Headquarters for upload with the Tabulator Client for central counting at the Tabulator.
  - **Ballot Reader** – The OVO’s ballot reader is a dual-sided scanner connected to the PC to scan data from marked ballot pages. The ballot reader ejects accepted ballot pages into an attached ballot box or rejects unaccepted ballot pages back out to the voter.
  - **Printer** – The OVO’s printer is a 58 mm thermal receipt printer connected to the PC used to print receipts and reports at the OVO.
  - **UPS** – The uninterruptible power supply (UPS) is a discretionary part of the system dedicated to the OVO and should be located at each polling location in the event of a power failure.
- **OpenElect Voting Interface-Vote Center (OVI-VC)** – the OVI-VC is a ballot marking device that enables voters to print regional ballots on Election Day and during early voting. The OVI-VC is ADA compliant. It assists voters, with varying levels of ability, through the election process, ballot review and printing functions. Once the ballot is printed, it is taken to the OVO to be cast.
  - **Personal Computer (PC)** – The computer component (with a 15” touch panel display) has pre-installed software that provides user interfaces for voting and maintenance. Election files generated by the EM are loaded manually via a USB TM. The election files also set passwords, parameters, audio and ballot styles for that election.
  - **Transport Media (TM)** – The transport media is USB device with 1 GB or larger storage capabilities that provides the means of transporting audit log files to the OCS system. The warehouse technician, upon return of the OVI-VC to the warehouse following an election, retrieves this TM and transports it to the central office for processing by the Election Manager component of the OCS.

- **Printer** – The OVI-VS has an 82.5 mm thermal receipt printer connected to the PC. The printer is used to print BMD ballots and the reports generated by the OVI-VC.
- **UPS** – The uninterruptible power supply is a discretionary part of the system. Each OVI-VC should have a dedicated UPS located at each polling location, to be used in the event of a power failure.
- **FreedomVote Tablet (FVT)** – the FVT is a tablet based, ballot marking device that enables voters to print regional ballots on Election Day and during early voting. The FVT is ADA compliant, assisting voters with varying levels of ability to vote, review and print their ballot. Once the ballot is printed, it is taken to the OVO to be cast. If allowed by the Jurisdiction, ballots cast on the FVT can be retracted for an Early Voting session.
  - **Tablet** – The Android tablet has a 13.3 inch touchscreen and comes with pre-installed software that provides user interfaces for voting and maintenance. Election files generated by the EM are loaded manually via a USB. The election files allow the jurisdiction to determine the FVT’s mode, and also set passwords, parameters, audio and ballot styles for that election.
  - **Barcode Reader** - 2D USB Barcode reader will read the 2D barcodes produced by the EM such as the initialize barcode and administrative/maintenance barcodes. It will also read the ‘populate’ barcode produced by other qualified systems.
  - **USB Hub** – A four-port USB hub is installed in the FVT case to connect the printer, barcode scanner and keypad to the tablet. The Election TM is inserted in the fourth port to upload election files.
  - **Printer** – An 82.5 mm thermal receipt printer is connected to the Tablet to print BMD ballots and reports.
  - **Optional ADA Devices** – 10-key keypad with Sip and Puff Interface, Headphones, Sip and Puff Device.
- **OpenElect Voting Central Scan (OVCS)** – is a ballot scanning system that is made up of a PC, bulk scanner and the OVCS software. The OVCS units reside at election headquarters and are used to read absentee, provisional or recount ballots in large jurisdictions.
  - **Laptop/PC Desktop** – The OVCS system will read absentee, recount, Early Voting, Vote Center and Election Day ballots. The results are uploaded to the OpenElect Central Scan (OCS) Tabulator without intermediate steps. The OVCS software will provide you with a variety of reports on Election Day, such as Write-in and Summary reports.
  - **Bulk Scanner** – a dual-sided scanner that is connected to the PC to scan data from marked ballots. There are currently two models of the scanner, the Canon DR-X10C Large Capacity Scanner and Canon DR-M160II Desktop Scanner.

## 1.2 References

- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume I, “Voting System Performance Guidelines”, and Volume II, “National Certification Testing Guidelines”
- Election Assistance Commission Testing and Certification Program Manual, Version 2.0
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 2.0
- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2020 Edition, “NVLAP Procedures and General Requirements (NIST Handbook 150)”, dated July 2020
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2017 Edition, “Voting System Testing (NIST Handbook 150-22)”, dated July 2017
- United States 107<sup>th</sup> Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Pro V&V, Inc. Quality Assurance Manual, Revision 7.0
- EAC Requests for Interpretation (RFI) and Notices of Clarification (NOC) (listed on [www.eac.gov](http://www.eac.gov))
- Pro V&V Test Report No. TR-01-01-UNI-005-01.02, “Test Report for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.1 Voting System”
- OpenElect Voting System Release Notes, System 2.1 to 2.2, Release 2.2, Version 1.5
- Unisyn Voting Solutions Technical Data Package (*A listing of the OpenElect 2.2 documents submitted for this test campaign is listed in Section 3.1.2 of this Test Report*)

## 1.3 Terms and Abbreviations

*This subsection lists terms and abbreviations relevant to the hardware, the software, or this Test Plan.*

“ADA” – Americans with Disabilities Act 1990

“BLM” – Ballot Layout Manager

“BMD” – Ballot Marking Device

“CM” – Configuration Management

“COTS” – Commercial Off-The-Shelf

“EAC” – United States Election Assistance Commission

“EM” – Election Manager

“EMS” – Election Management System

“EOS” - Election Operating System

“FCA” – Functional Configuration Audit

“FVS” – FreedomVote Scan

“FVT” – FreedomVote Tablet

“FVT-B” – FreedomVote Tablet with Battery Backup

“LAT” – Logic and Accuracy Test

“NOC” – Notice of Clarification

“OCS” – OpenElect Central Suite

“OVCS” – OpenElect Voting Central Scan

“OVI-VC” – OpenElect Voting Interface – Vote Center

“OVO” – OpenElect Voting Optical

“OVS” – OpenElect Voting System

“PC” – Personal Computer

“PCA” – Physical Configuration Audit

“QA” – Quality Assurance

“RFI” – Request for Interpretation

“RCV” – Rank Choice Voting

“SCAP” – Security Content Automation Protocol

“TC” – Tabulator Client

“TDP” – Technical Data Package

“TM” – Transport Media (USB Thumb Drive)

“TR” – Tabulator Reports

“UPS” – Uninterruptible Power Supply

“VSTL” – Voting System Test Laboratory

“VVSG” – Voluntary Voting System Guidelines

## 2.0 CERTIFICATION TEST BACKGROUND

OVS 2.2 is a modification of a previously certified system (OVS 2.1). Pro V&V performed an evaluation of results from the previous test campaign to determine the scope of testing required for certification of the OVS 2.2. Based on this evaluation, Pro V&V determined that testing from the previous test campaign would establish the baseline and that the focus of this test campaign would be on the documented system updates.

### 2.1 Revision History

The table below details the version history of the OVS 2.2 System:

**Table 2-1. OVS 2.2 System Revision History**

System Version	Certification Type	Baseline System	Certification Number
OVS 2.0	New System	--- (Original System)---	UNS10121966-2.0
OVS 2.0.A	Modification	OVS 2.0	UNS10121966-2.0.A
OVS 2.1	Modification	OVS 2.0.A	UNS10121966-2.1
OVS 2.2	Modification	OVS 2.1	*UNS10121966-2.2

\*Upon grant of certification by the EAC

### 2.2 Scope of Testing

The scope of testing is limited to the modifications/enhancements implemented since the certification of the baseline system. These modifications include updates to various components of the OpenElect Voting System, the introduction of the end user enhancements, the addition of the FreedomVote Tablet with Battery Backup (FVT-B), the addition of the FreedomVote Scan (FVS) and the new OVCS scanner, the Canon DR-G2140.

Based on this assessment, it was determined that multiple areas within the EAC 2005 VVSG would be evaluated to encompass the required tests. A breakdown of the areas and associated tests is listed below:

- EAC 2005 VVSG Volume 1, Section 2: Functional Requirements
  - System Integration Testing
  - Functional Configuration Audit (FCA)
  - Physical Configuration Audit (PCA), including System Loads & Hardening
  - Technical Documentation Package (TDP) Review
  - Volume & Stress Testing
  - Accuracy Testing
- EAC 2005 VVSG Volume 1, Section 3: Usability & Accessibility

- Usability & Accessibility Testing
- Technical Documentation Package (TDP) Review
- EAC 2005 VVSG Volume 1, Section 4: Hardware Requirements
  - Hardware Testing
  - Technical Documentation Package (TDP) Review
- EAC 2005 VVSG Volume 1, Section 5: Software Requirements
  - Source Code Review, Compliance Build, Trusted Build, and Build Document Review
  - Technical Documentation Package (TDP) Review
  - Functional Configuration Audit (FCA)
- EAC 2005 VVSG Volume 1, Section 7: Security Requirements
  - Security Testing
  - Technical Documentation Package (TDP) Review
  - Functional Configuration Audit (FCA)

## 2.2.1 Modification Overview

The OVS 2.2 Voting System is a modified voting system configuration that contains updates to various components of the OpenElect Voting System as well as the addition of the OpenElect FreedomVote Scan (FVS) and the Canon DR-G2140 (OVCS) central count tabulator. The FVT has end of life electrical components that are being replaced within this release, as well as an internal battery backup unit installed. This release incorporates specific enhancement requests primarily centered on improving the end user experience.

### 2.2.1.1 Detailed List of Changes

The list below includes the submitted software changes between the OVS 2.2 system and the baseline of the OVS 2.1 Voting System as derived from the OpenElect Voting System Release Notes, System 2.1 to 2.2, Release 2.2, Version 1.5:

#### **Auditor (A)**

- *Reference Number 2.2-1:* Add ability for operator to swap left/right images.
- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.

## **Ballot Layout Manager (BLM)**

- *Reference Number 2.2-2:* Adjust BMD length calculation to accommodate voting options and font sizes.
- *Reference Number 2.2-3:* Increase speed of backup/restore UDB process.
- *Reference Number 2.2-4:* Enforce type limitation on precinct splits. (Normal precincts must have at least one normal split, absentee etc. precincts can only have splits of same type.)
- *Reference Number 2.2-5:* Improvements to speed and balancing of proportional rotation function. Ignore absentee precincts in counts.
- *Reference Number 2.2-6:* Add ability to move groups of contests in contest reorder interface.
- *Reference Number 2.2-7:* Show dynamically generated IDs for contest/candidate in interface.
- *Reference Number 2.2-8:* Export and import rotation point in precinct interface.
- *Reference Number 2.2-9:* Add alignment option (left or center) to BLM interface.
- *Reference Number 2.2-50:* Adjust font size calculations so that candidate name text is centered on target.
- *Reference Number 2.2-57:* Update to default messages for Overvote and English Message for Display on Bilingual OVO/FVS screen. In support of 2.2-46 and 2.2-47.
- *Reference Number 2.2-58:* FVT ballotstyles will have a minimum of 12 timing marks (up from 7).
- *Reference Number 2.2-61:* Measure Preview must show the alternate language translation.
- *Reference Number 2.2-62:* Updates to handling deleted elements in header/graphics interface.

## **Election Manager (EM)**

- *Reference Number 2.2-10:* Add FVS machine type and specific FVS options.
- *Reference Number 2.2-11:* Add option for type of write report (compressed or expanded) to be selected at EM, and not on close in OVO/FVS.
- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.

- *Reference Number 2.2-28:* Allow operator to set default number of open / close reports to print.
- *Reference Number 2.2-42:* Add (optional) count of ballots with write-ins to tally.
- *Reference Number 2.2-49:* All EM options are disabled after election export.

### **FreedomVote Tablet (FVT)**

- *Reference Number 2.2-9:* Handle BLM defined left/center alignment option on the ballot display.
- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.
- *Reference Number 2.2-14:* Make training mode on FVT function more like election-day for training purposes.
- *Reference Number 2.2-15:* Remove user confirmation when USB is inserted in FVT.
- *Reference Number 2.2-16:* Ensure the ballots look consistent (font, format, etc.) from ballot to screen.
- *Reference Number 2.2-17:* Support multiple cross party endorsements for a single candidate.
- *Reference Number 2.2-19:* Only one vote assigned to each write-in in Test Deck generation, no longer part of the sequence.
- *Reference Number 2.2-20:* When a contest does not have enough candidates to fulfill the vote for value, the second chance validation will not flag them as undervotes.
- *Reference Number 2.2-41:* New FVT-B includes an internal battery backup unit to power the printer for two hours in the event of a power failure. In all other ways, the FVT-B functions the same as the FVT.
- *Reference Number 2.2-45:* Add Shutdown screen to Close process and allow tablet to be shut off from physical switch.

### **OCS Installer**

- *Reference Number 2.2-46:* Update to a new FIPS cryptographic module.

### **OpenElect Voting Interface (OVI-VC)**

- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.

- *Reference Number 2.2-20:* When a contest does not have enough candidates to fulfill the vote for value, the second chance validation will not flag them as undervotes.

### **OpenElect Voting Central Scan (OVCS)**

- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.
- *Reference Number 2.2-20:* When a contest does not have enough candidates to fulfill the vote for value, the second chance validation will not flag them as undervotes.
- *Reference Number 2.2-21:* Add Canon G2140 to OVCS.
- *Reference Number 2.2-22:* Add Ballot Count to OVCS upload screen.
- *Reference Number 2.2-24:* Write-in extraction algorithm improvement.
- *Reference Number 2.2-42:* Add (optional) count of ballots with write-ins to tally.
- *Reference Number 2.2-43:* Only read Code 128 barcodes on FVT ballots.
- *Reference Number 2.2-44:* Allow systems to accept multiple page ballots with retraction IDs.
- *Reference Number 2.2-47:* Add overvote and undervote counts to tally.
- *Reference Number 2.2-59:* Simplification to OCR for write in image extraction to remove chance for false positives on write in identification.

### **OpenElect Voting Optical Scan (OVO)**

- *Reference Number 2.2-11:* Add option for type of write-in report (compressed or expanded) to be selected at EM, and not on close in OVO/FVS.
- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.
- *Reference Number 2.2-23:* Prevent ballot hang at back of OVO.
- *Reference Number 2.2-24:* Write-in extraction improvement (in line with OVCS.)
- *Reference Number 2.2-25:* Speed up closing process (background thread to sign images and extract write-ins) and efficiency improvements.
- *Reference Number 2.2-26:* Updated jam after cast handling. If jammed after cast, a voter message will display telling them to request poll worker assistance. When the 'Continue' button is selected, the next screen requires the Election password screen input by the poll worker.

Then the system will then attempt to eject to the ballot box again, if not successful, it will eject the ballot to the front with a screen messaging telling the poll worker that special handling is required.

- *Reference Number 2.2-27:* On full review screen: Cast and Return buttons are always enabled.
- *Reference Number 2.2-28:* Allow operator to set default number of open / close reports to print.
- *Reference Number 2.2-29:* If write-in report is cancelled, do not print signature lines, instead print that report was cancelled.
- *Reference Number 2.2-30:* Add ability to support scaling of ballot image on paper down to 96%.
- *Reference Number 2.2-42:* Add (optional) count of ballots with write-ins to tally.
- *Reference Number 2.2-43:* Only read Code 128 barcodes on FVT ballots.
- *Reference Number 2.2-44:* Allow systems to accept multiple page ballots with retraction IDs.
- *Reference Number 2.2-51:* Add manual Connect to Scanner function.
- *Reference Number 2.2-52:* OVO warns of consequences of overvote in all modes and on ballot alert print.
- *Reference Number 2.2-53:* Bilingual message pages default text is correct and understandable in both languages.
- *Reference Number 2.2-55:* Remove Accuracy Test function.
- *Reference Number 2.2-59:* Simplification to OCR for write in image extraction to remove chance for false positives on write in identification.
- *Reference Number 2.2-60:* Add translation of measure responses to full review display.

#### **Tabulator (TAB)**

- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.
- *Reference Number 2.2-31:* Allow VR totals by party to be input for all defined parties.
- *Reference Number 2.2-32:* Aggregate party VR totals when validating ballot counts on upload.
- *Reference Number 2.2-33:* Support for RCV Single Transferable Vote.

- *Reference Number 2.2-34:* Add option to allow RCV tally to continue beyond minimum winning threshold.
- *Reference Number 2.2-35:* Add show splits button on upload interface to make it easier to determine which splits have not reported.
- *Reference Number 2.2-36:* Improve handling of write-ins for RCV. See Tabulator User Guide, Section 5.3.2 (pg. 5-25) for details.
- *Reference Number 2.2-37:* On export, RCV contests only export the first rank contests.
- *Reference Number 2.2-38:* Add support for FVS devices.
- *Reference Number 2.2-42:* Add (optional) count of ballots with write-ins to tally.
- *Reference Number 2.2-56:* Multi-seat RCV + elimination only option – allow candidates below threshold to accumulate votes after winner has been calculated.

#### **Tabulator Reports (TR)**

- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.
- *Reference Number 2.2-39:* Choose all precincts and contests by default when generating reports.
- *Reference Number 2.2-40:* Filter SOVC report so that a contest only shows precincts that it is assigned to.
- *Reference Number 2.2-42:* Add (optional) count of ballots with write-ins to tally.

#### **Tabulator Client (TC)**

- *Reference Number 2.2-12:* Add support for (optional) strong election/maintenance passwords.
- *Reference Number 2.2-38:* Add support for FVS devices.

#### **FreedomVote Scan (FVS)**

- *Reference Number 2.2-13:* Add FreedomVote Scan to OpenElect product.

#### **Cast Vote Records Utility (CVR)**

- *Reference Number 2.2-48:* Add Cast Vote Records Utility to OpenElect product.

#### **Write-in Utility (WI)**

- *Reference Number 2.2-54:* Add Write-in Utility to OpenElect product.

## 2.2.2 Block Diagram

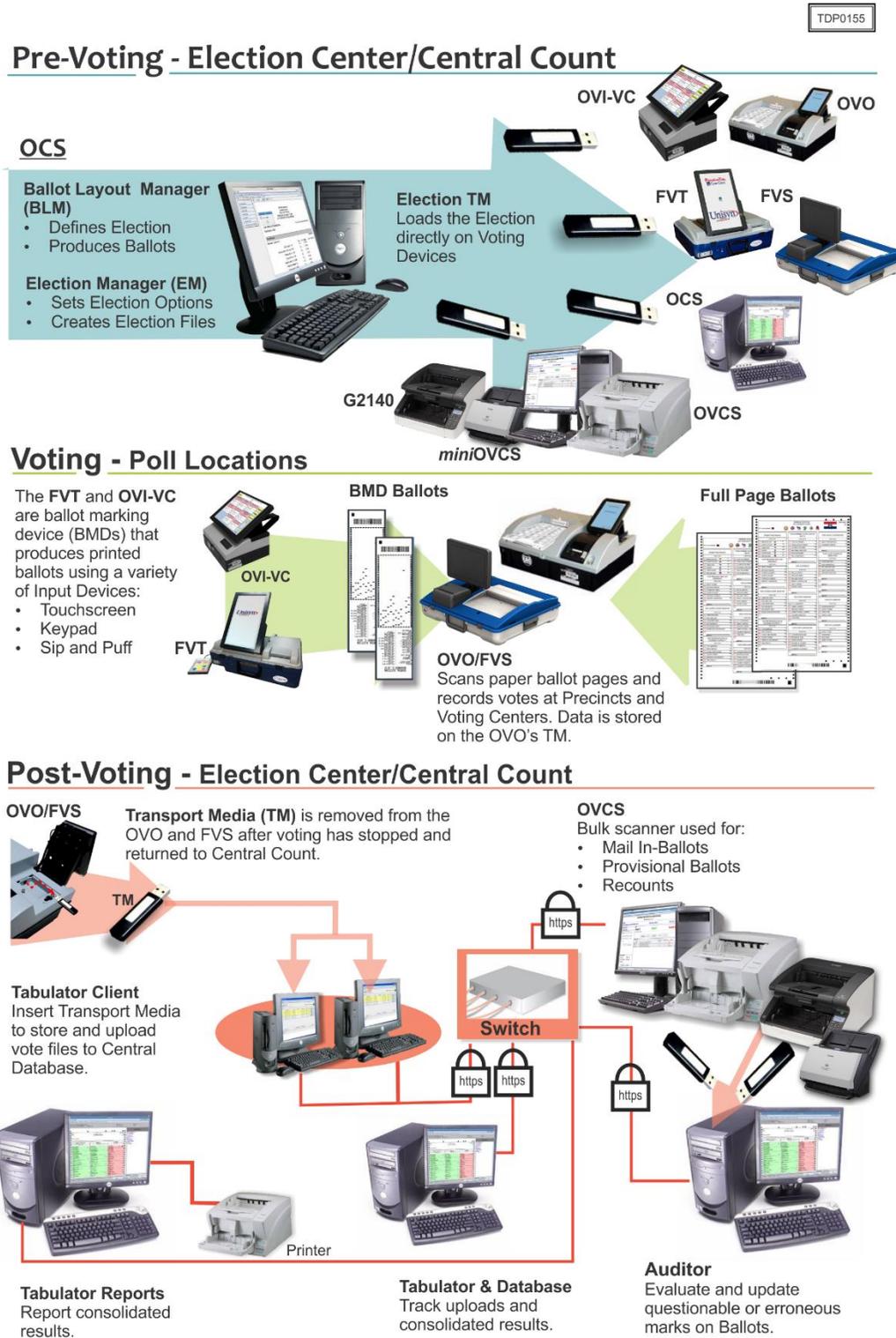


Figure 1-5. OVS 2.2 System Components Overview

### 2.2.3 System Limits

Unisyn has defined the following system performance characteristic limits for the OVS 2.2:

- The OCS and OVCS Software are intended for use by a single jurisdiction with one set of districts, voting centers, and precincts at any given time.
- The OCS and OVCS designed for handling up to 20 consecutive elections.
- Ten elections may be stored in the OCS database simultaneously.
- The system allows 400 ballot styles for an election.
- One OVO and FVS can be initialized for use with ballots from 1-50 precincts, or all precincts.
- An OVI-VC and FVT can present all precincts to the voter.
- The system allows voting by precinct and split precinct.
- The OVO and FVS provide several voting sessions to accommodate different ballot counting purposes. Only one session can be used at a time:
  - **Election Day** voting at the polls and voting centers
  - **Training Election** voting for training or sales purposes
  - **Logic Test** voting to test data and tabulation
  - **Absentee** session
  - **Recount** session
  - **Provisional** session
  - **Regional Early Voting** session
- The OVO/FVS provides the following System Performance:
  - Expected speed (per ballot page) 4 seconds to ballot page confirm
  - Throughput capacity (per ballot page) 6 ballot pages per minute
  - Maximum Volume 5,000 ballot pages
  - Ballot Pages
    - 11" ballot page:
      - Maximum number of voting positions per ballot page (11 inch ballot pages, without Rank Choice Voting): 228
      - Maximum number of voting positions per ballot page (11 inch ballot pages, with Rank Choice Voting): 456
    - 14" ballot page:

- Maximum number of voting positions per ballot page (14 inch ballot pages, without Rank Choice Voting): 300
  - Maximum number of voting positions per ballot page (14 inch ballot pages, with Rank Choice Voting): 600
- 17” ballot page:
  - Maximum number of voting positions per ballot page (17 inch ballot pages, without Rank Choice Voting): 372
  - Maximum number of voting positions per ballot page (17 inch ballot pages, with Rank Choice Voting): 744
- 19” ballot page:
  - Maximum number of voting positions per ballot page (19 inch ballot pages, without Rank Choice Voting): 420
  - Maximum number of voting positions per ballot page (19 inch ballot pages, with Rank Choice Voting): 840
- Maximum number of ballot styles: 50 ballot styles per OVO session if individually entered with a maximum of 400 ballot style choices. For All Precinct sessions, all ballot styles are accepted by the OVO/FVS.
- The OVCS provides several voting sessions to accommodate different ballot counting purposes. Only one session can be used at a time:
  - Normal - Election Day Tabulation
    - Election Day Tabulation
    - Recount
    - Training
  - LAT - Logic and Accuracy Test (LAT) voting to test data and tabulation
  - Absentee session
  - Provisional session
  - Write-In only session
- The OVCS Large scanners provide the following System Performance:
  - Max Ballot pages per batch 500
  - Max Ballot pages per session 5,000
  - Expected speed (ballot pages per hour) 2,100 ballot pages per hour
  - Maximum number of ballot styles: 400 ballot style choices
- The mini OVCS scanner provides the following System Performance:
  - Max Ballot pages per batch 50
  - Max Ballot pages per session 5,000
  - Expected speed (ballot pages per hour) 350 ballot pages per hour

- Maximum number of ballot styles: 400 ballot style choices

In the end-to-end OVS, a single election is limited to:

- Up to 10 political parties (including non-partisan) voting their own ballot in a Primary Election. Up to 10 political parties (including non-partisan) voting in a General Straight Ticket Election. 50 parties may appear on the ballot for candidates.
- Up to 2,000 precincts.
- Up to 160 candidates per contest, with a limit of 3,000 combined count of candidates and contests.
- Up to 10 language translations (applies to ballot pages).
- Up to 3 ballot pages per ballot.
- Up to 5,000 ballot pages processed (cast votes) at an OVO/FVS during a single voting session.

#### **2.2.4 Supported Languages**

The submitted voting system supports the following languages: Hindi, Chinese, English, Japanese, Korean, Navajo, Spanish, and Thai. Support for all stated languages was verified; however, only English and Spanish language ballots were cast during the performance of functional testing. Additionally, one character based language (Chinese) was tested during System Integration Testing.

For the character based language, the ballot was created by Pro V&V and voted utilizing both paper ballots and ADA voting devices along with all applicable peripherals. The Chinese Language for the ballot was created using a readily available online translation tool. The translated language text was entered into the Ballot Layout Manager (BLM) Application. A ballot preview was then generated in the BLM application. The Chinese characters displayed in the ballot preview were compared to the characters generated by the online translation tool, to ensure that the characters matched. The ballots were then generated and printed, and the election loaded onto the tabulators and the BMD units. The Chinese characters displayed on both the printed ballots and displayed on the BMD units were compared to the original Chinese Characters generated by the online translation tool to verify that the characters matched.

#### **2.2.5 Supported Functionality**

The OVS 2.2 is designed to support the following voting variations:

- General Elections.
- Closed Primaries.
- Open Primaries.
- Modified Open Primaries.
- Partisan offices.

- Non-partisan offices.
- Write-in voting.
- Primary presidential delegation nominations.
- Ballot rotation.
- Straight party voting.
- Cross-party endorsement.
- Split precincts.
- Vote for N of M.
- Recall issues.
- Ranked Choice Voting with Single Transferrable Vote.
- Provisional or challenged ballots.
- Absentee ballots.

Additionally, OVS 2.2 accounts for:

- • Pennsylvania Straight Ticket support.
- • Indiana Straight Ticket support.
- • Proportional Rotation.
- • Checking and notification of overvote and undervote conditions.
- Ballots in multiple languages.
- Ballots consisting of multiple ballot pages.

#### **2.2.6 VVSG**

The OVS 2.2 was evaluated against the relevant requirements contained in the EAC 2005 VVSG, Version 1.0.

#### **2.2.7 RFIs**

There are no RFIs released by the EAC as of the date of this Test Report that pertain to this test campaign that were not in effect at the time of the baseline system certification.

#### **2.2.8 NOCs**

There are no NOCs released by the EAC as of the date of this Test Report that pertain to this test campaign that were not in effect at the time of the baseline system certification.

### **3.0 TEST FINDINGS AND RECOMMENDATIONS**

The OVS 2.2 was evaluated against all applicable requirements contained in the EAC 2005 VVSG, Volumes I and II. The acceptable range for system performance and the expected results for each test case utilized during the test campaign were derived from the manufacturer-submitted technical documentation and the EAC 2005 VVSG. Test cases provided information regarding the sequence of actions to be performed for the execution of a test, the requirements being met, the test objective, test configuration, equipment needed, special requirements, assumptions, and pass/fail criteria.

The summary findings and recommendations for each area of testing are provided in the following sections.

#### **3.1 Summary Findings and Recommendations**

Summary findings for the System Level Testing (System Integration Testing, Accuracy Test, Volume & Stress Testing, and FCA), Hardware Testing, Usability & Accessibility Testing, Security Testing, TDP Review, Source Code Review, and PCA (including System Loads & Hardening) are detailed in the relevant sections of this report. In addition to these areas of testing, a QA & CM System Review was performed, as described below.

##### **QA & CM System Review**

The Unisyn Quality and Configuration Management Manuals were reviewed for their fulfillment of Volume I, Sections 8 and 9, and the requirements specified in Volume II, Section 2. The requirements for these sections establish the quality assurance and configuration standards for voting systems to which manufacturers must conform and require voting system manufacturers to implement a quality assurance and configuration management program that is conformant with recognized ISO standards. As part of the review process, the Unisyn TDP documents were reviewed to determine if the stated policies were being followed.

##### **Summary Findings**

This evaluation utilized the TDP Review in conjunction with the PCA to determine compliance to the EAC 2005 VVSG requirements and the requirements stated in the Unisyn technical documentation. The review of the Quality Assurance and Configuration Management documentation focused on Unisyn's adherence to its stated QA and CM processes. No discrepancies were noted during the reviews

#### **3.1.1 Physical Configuration Audit**

The Physical Configuration Audit (PCA) compares the voting system components submitted for qualification to the manufacturer's technical documentation. The PCA includes the following activities:

- Establish a configuration baseline of software and hardware to be tested; confirm whether manufacturer's documentation is sufficient for the user to install, validate, operate, and maintain the voting system

- Verify software conforms to the manufacturer's specifications; inspect all records of manufacturer's release control system; if changes have been made to the baseline version, verify manufacturer's engineering and test data are for the software version submitted for certification
- If the hardware is non-COTS, Pro V&V shall review drawings, specifications, technical data, and test data associated with system hardware to establish system hardware baseline associated with software baseline
- Review manufacturer's documents of user acceptance test procedures and data against system's functional specifications; resolve any discrepancy or inadequacy in manufacturer's plan or data prior to beginning system integration functional and performance tests
- Subsequent changes to baseline software configuration made during testing, as well as system hardware changes that may produce a change in software operation are subject to re-examination

### Summary Findings

The OVS 2.2 consists of the following major components: the OCS, OVO precinct scanner, FVS precinct scanner, OVI-VC precinct voting interface, OVCS central count scanner, and FVT precinct voting tablet. All components of the OVO, excluding the case, are COTS. All components of the OVI-VC, excluding the case and keypad, are COTS. All components of the FVT, excluding the case, tablet enclosure, and keypad, are COTS. All OVCS components are COTS. All components of the FVS, excluding the case, are COTS. All OCS functions are handled by proprietary software running on COTS PS/laptop/servers.

During execution of the PCA, the components of the OVS 2.2 were documented by component name, model, serial number, major component, and any other relevant information needed to identify the component. For COTS equipment, every effort was made to verify that the COTS equipment had not been modified for use. Additionally, each technical document submitted in the TDP was recorded by document name, description, document number, revision number, and date of release. At the conclusion of the test campaign, test personnel verified that any changes made to the software, hardware, or documentation during the test process were fully and properly documented.

### **3.1.2 TDP Review**

In order to determine compliance of the modified TDP documents with the EAC 2005 VVSG, a limited TDP review was conducted. This review focused on TDP documents that have been modified since the certification of the baseline system. The review consisted of a compliance review to determine if each regulatory, state, or manufacturer-stated requirement had been met based on the context of each requirement. Results of the review of each document were entered on the TDP Review Checklist and reported to the manufacturer for disposition of any anomalies. This process was ongoing until all anomalies were resolved.

Summary Findings

The submitted TDP was determined to be in compliance with the requirements set forth in the EAC 2005 VVSG. A listing of all documents contained in the OVS 2.2 TDP is provided in Table 3-1.

**Table 3-1. OVS 2.2 TDP Documents**

<b>Document Number</b>	<b>Description</b>	<b>Version</b>	<b>Release</b>
04-00512	Technical Data Package-Document List and Version Control	1.1	2.2
04-00446	OVS System Overview	1.5	2.2
04-00444	System Functionality Description	1.1	2.2
04-00458	System Hardware Specification	1.3	2.2
04-00464	Software Design and Specification	1.1	2.2
04-00447	System Security Specification	1.1	2.2
04-00453	System Test and Verification Plan	1.0	2.2
04-00460	Systems Operations Procedure: Warehouse Technician's Guide	1.3	2.2
04-00459	System Maintenance Procedures	1.2	2.2
04-00445	Personnel Training and Deployment Requirements	1.0	2.2
04-00448	Configuration Management Plan	1.1	2.2
04-00454	Quality Assurance Plan	1.1	2.2
04-00469	Final Quality Assurance Report	1.2	2.2
04-00427	Election Manager User Guide	1.1	2.2
04-00428	Ballot Layout Manager User Guide	1.1	2.2
04-00431	Tabulator Client User Guide	1.0	2.2
04-00432	Tabulator User Guide	1.1	2.2
04-00433	Tabulator Reports User Guide	1.1	2.2
04-00495	OVCS User Guide	1.4	2.2
04-00530	Auditor Users Guide	1.2	2.2
04-00549	EOS Linux and OCS Installation Guide	1.1	2.2
04-00449	System Coding Standards	1.0	2.2
04-00462	Election Day Troubleshooter's Guide	1.3	2.2
04-00463	Election Day Poll Worker's Guide	1.4	2.2
04-00494	OVS Acronyms	1.1	2.2
04-00503	OVS Paper Specification	1.0	2.2
04-00513	Hardware Verification	1.1	2.2
04-00542	Requirements of the 2005 VVSG Trace To Vendor Testing and Technical Data Package	1.0	2.2
04-00594	OpenElect Voting System Release Notes, 2.1 to 2.2	1.5	2.2
04-00606	Write-in Utility User Guide	1.1	2.2
04-00607	Cast Vote Record User Guide	1.0	2.2
04-00553	Trusted Build – Applications 2.2	2.10	2.2
04-00602	FVS Trusted Build 1.0	1.4	1.0

### 3.1.3 Source Code Review, Compliance Build, Trusted build, and Build Documentation Review

The OCS/OVO/FVS/OVI-VC/OVCS software is a set of Java applications that utilize open source libraries and run on a customized Linux operating system to take advantage of that platform's security and performance. The OVO, FVS, and OVCS use the Java Native Interface (JNI) classes, which are C++ classes, to communicate with the native drivers (also C++) provided by the hardware manufacturer. This is required by the Optical Scanner in the OVO, FVS and the OVCS. The OpenElect system is designed for use in two distinct locales: Central Processing and In-Precinct Systems.

The FreedomVote Tablet (FVT) product is also written in Java, but compiled for use on the Google Android operating system, using different core libraries.

#### Summary Findings

Pro V&V reviewed the submitted source code to the EAC 2005 VVSG and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V verified that the submitted documentation was sufficient to enable: (1) a review of the source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met.

The submitted source code was compared to the previously certified versions to determine the changes, if any. A combination of Automated Source Code Review and Manual Source Code Review methods was used to review the changes in the source code. In addition, 10% of the source code comments were manually reviewed.

- Automated Source Code Review: The Automated Source Code Review was performed during the OCS applications, OVO, OVI-VC, FVT, and OVCS Compliance and Trusted Builds. No source code issues were found during the Automated Source Code review
- Manual Source Code Review: The Manual Source Code review was performed prior to the Compliance and Trusted Builds. The Manual Source Code was a comparison between the previously certified source code and the source code submitted for this test campaign
- Compliance Build: The compliance build was performed following the compliance review. Once the compliance review was performed and the source was deemed stable enough to proceed with testing, the source code and all additional packages were compiled into a Compliance Build.
- Trusted Build: The trusted build consisted of inspecting the Unisyn-submitted source code, COTS, and Third Party software products and combining them to create the executable code. This inspection followed the documented process from the "United States Election Assistance Commission Voting System Testing and Certification Program Manual" Section 5.5 – 5.7. Performance of the trusted build included the build documentation review. The Trusted Build was performed following the completion of the Accuracy Test.

### **3.1.4 System Level Testing**

System Level testing included the limited Functional Configuration Audit (FCA), Regression Testing, Accuracy Testing, and the System Integration Tests. System Level testing was implemented to evaluate the complete system. During test performance, Pro V&V personnel configured the system as it would be for normal field use by following the procedures detailed in the OVS 2.2 voting system technical documentation. This included connecting all supporting equipment and peripherals including ballot boxes, voting booths (regular and accessible), and any physical security equipment such as locks and ties.

System Level Testing included all proprietary components and COTS components (software, hardware, and peripherals) in both the EMS Standard and EMS Express system configurations. For software system tests, the tests were designed according to the stated objective without consideration of its functional specification. The system level hardware and software test cases were prepared independently to assess the response of the hardware and software to a range of conditions.

#### **3.1.4.1 System Integration Testing**

System Integration testing evaluated the integrated operation of both hardware and software. Compatibility of the voting system software components or subsystems with one another, and with other components of the voting system environment, was determined through functional tests integrating the voting system software with the remainder of the system. The System Integration Tests were performed to verify the OVS 2.2 functioned as a complete system.

##### **Summary Findings**

To evaluate the integration of the system components and to perform the necessary regression testing, 3 General Elections and 3 Primary Elections were successfully exercised on the voting system, as described below:

Three general elections with the following breakdowns:

- General Election GEN-01: A basic election held in four precincts, one of which is a split precinct. This election contains nineteen contests compiled into four ballot styles. Five of the contests are in all four ballot styles. The other fourteen contests are split between at least two of the precincts with a maximum of four different contest spread across the four precincts.
- General Election GEN-02: A basic election held in three precincts. This election contains fifteen contests compiled into three ballot styles. Ten of the contests are in all three ballot styles with the other five split across the three precincts.
- General Election GEN-03: A basic election held in two precincts. This election contains eight contests and compiled into two ballot styles. Four of the contests are in both ballot styles. The other four contests are split between the two precincts. This election is designed to functionally test the handling of multiple ballot styles, support for at least

three languages including a character-based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device.

Three primary elections with the following breakdowns:

- Primary Election PRIM-01: Open Primary Election in two precincts. This election contained thirty contests compiled into five ballot styles. Each ballot style contains six contests.
- Primary Election PRIM-02: Open Primary Election held in two precincts. This election contained thirteen contests compiled into three ballot styles. One contest is in all three ballot styles; all other contests are independent.
- Primary Election PRIM-03: A basic election held in two precincts. This election contains ten contests and is compiled into two ballot styles. Two of the contests are in both ballot styles. The other eight contests are split between the two parties' ballots. This Primary Election is designed to functionally test the handling of multiple ballot styles, support for at least three languages including a character-based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device.

The OVS 2.2 System successfully passed the System Integration Test. During execution of the test procedure, it was verified that the OVS 2.2 System successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results.

#### **3.1.4.2 Functional Configuration Audit (FCA)**

The FCA for this test campaign included an assessment of the submitted modifications and tests conducted to verify that the system hardware and software performed as described in the manufacturer's documentation. This evaluation utilized baseline test cases as well as specifically designed test cases and included predefined election definitions for the input data.

##### **Summary Findings**

The FCA was performed on the OpenElect 2.2 system to test the functional changes made to the system. Specially designed test cases were executed to assess that the changes perform as described in the system documentation. Regression testing was performed as needed to verify all noted deficiencies were successfully addressed.

#### **3.1.4.3 Accuracy Test**

The accuracy test ensured that each component of the voting system could each process at least 1,549,703 consecutive ballot positions correctly within the allowable target error rate. The Accuracy test was designed to test the ability of the system to "capture, record, store, consolidate and report" specific selections and absences of a selection. The required accuracy was defined as an error rate. This rate is the maximum number of errors allowed while processing a specified

volume of data. For paper-based voting systems the ballot positions on a paper ballot must be scanned to detect selections for individual candidates and contests and the conversion of those selections detected on the paper ballot converted into digital data.

#### Summary Findings

During Accuracy Testing, the OVO and OVCS were tested by utilizing a combination of hand marked (70%) and pre-marked (30%) ballots to achieve accuracy rate greater than 1,549,703 correct ballot positions. The OVI-VC and FVT were utilized to create ballots that were implemented as part of the pre-marked test deck.

The OVS 2.2 System successfully passed the Accuracy Test. During execution of the test procedure, it was verified that the OVS 2.2 System successfully completed the test with all actual results obtained during test execution matching the expected results.

### **3.1.5 Volume & Stress**

The Volume & Stress Test investigates the system's response to conditions that tend to overload the system's capacity to process, store, and report data.

The test parameters focused on the system's stated limits and the ballot logic for areas such as the maximum number of active voting positions, maximum number of ballot styles, maximum candidates, maximum contests, and stated limits within the EMS. This test was utilized to ensure the system can achieve the manufacturer's TDP claims of what the system can support. Testing was performed by exercising an election definition and test cases developed specifically to test for volume and stress conditions of the system being tested.

#### Summary Findings

Volume & Stress test results from the certification test campaign on the baselined system were re-used to meet the requirements for this test campaign for the OCS, OVO, OVI-VC, OVCS, and FVT components of the OVS 2.2. The evaluation for this campaign focused on the FVS. During the Volume & Stress test, it was verified that the FVS successfully completed the evaluation with all actual results obtained during test execution matching the expected results.

### **3.1.6 Security Testing**

The objective of the security testing was to evaluate the effectiveness of the voting system in detecting, preventing, recording, reporting, and recovering from security threats. To assess system integrity, Pro V&V developed specifically designed test cases in an attempt to defeat the access controls and security measures documented in the system TDP.

The test methods for performing the security testing were execution and review. Prior to performance of security testing, the examiner verified that security hardening scripts have been properly applied to system components per the system documentation. The examiner reviewed the submitted TDP to verify that documented access and physical controls are in place. Following the documented procedures, the examiner configured the voting system for use and

functionality to verify that the documented controls were in place and adequate and met the stated requirements.

Physical security was tested by setting up the system as described in the TDP and then examining the effectiveness and comprehensiveness of physical security measures. Administrative Security was tested by examining the system’s documented security instructions and procedures for effectiveness and breadth. Logical Security was tested by performing a review of the SCAP checklist against the FVS precinct count tabulator.

Summary Findings:

The SCAP checklist used for the review was CIS CentOS Linux 8 Benchmark v1.0.0 – 10-31-2019. During the review, this checklist was utilized to compare the operating system settings of the OVS 2.2 to the benchmark. As a result of the Security Review, it was determined that the OVS 2.2 met the VVSG 1.0 security requirements. Any deviations encountered during testing were successfully resolved.

**3.1.7 Hardware Testing**

Previous hardware examinations were performed on the certified baseline system (OVS 2.1). The addition of the FVS to the modified system required the full suite of hardware and electrical testing as detailed in the 2005 VVSG. The addition of the Canon DR-G2140 COTS central count device required it to undergo temperature power variation and electrical supply testing. In addition to the FVS testing, the FVT has end of life electrical components being replaced in this release. Based on these changes, the FVT was subjected to the full suite of electrical testing as well as temperature power variation testing. These tests are listed below and marked as applicable:

**Table 3-2. Hardware Test Requirements**

Test	System Component		
	FVS	FVT	OVCS
<i>Electrical Tests</i>			
Electrical Power Disturbance	X	X	N/A
Electromagnetic Radiation	X	X	N/A
Electrostatic Disruption	X	X	N/A
Electromagnetic Susceptibility	X	X	N/A
Electrical Fast Transient	X	X	N/A
Lightning Surge	X	X	N/A
Conducted RF Immunity	X	X	N/A
Magnetic Fields Immunity	X	X	N/A
Electrical Supply	X	X	X
<i>Environmental Tests</i>			
Bench Handling	X	N/A	N/A
Vibration	X	N/A	N/A
Low Temperature	X	N/A	N/A
High Temperature	X	N/A	N/A

**Table 3-2. Hardware Test Requirements** (continued)

Test	System Component		
	FVS	FVT	OVCS
Humidity	X	N/A	N/A
Temperature Power Variation	X	X	X

Pro V&V utilized third party testing during the performance of hardware testing. All hardware testing was performed at the NTS Longmont facility located in Longmont, Colorado. All testing was witnessed on-site by Pro V&V personnel, with the exception of Temperature Power Variation in which Pro V&V qualified staff executed all testing at the NTS Longmont facility.

Summary Findings

Electrical Testing was performed on the components listed above. The procedures and results for this testing are included in the following NTS Test Reports:

FVT:

- NTS Test Report ETR-PR121029-00 Revision 0, presented in Attachment A, Part 1
- NTS Test Report ITR-PR121029-00 Revision 1, presented in Attachment A, Part 2

FVS:

- NTS Test Report ETR-PR121029-2 Revision 0, presented in Attachment A, Part 3
- NTS Test Report ITR-PR121029-3 Revision 0, presented in Attachment A, Part 4

The test results from this testing are summarized in Table 3-3.

**Table 3-3. Electrical Hardware Test Results**

Standard/Method	Description	Criteria	Class/Level	Result
FCC 15.107 ICES-003 VVSG Vol. 1 4.1.2.9	Power Line Conducted Emissions	N/A	Class B	Compliant
FCC 15.109 ICES-003 VVSG Vol. 1 4.1.2.9	Radiated Emissions	N/A	Class B	Compliant
EN61000-4-11 VVSG Vol. 1 4.1.2.5	Electrical Power Disturbance	Normal Operation & No Data Loss	Various	Compliant
EN61000-4-4 VVSG Vol. 1 4.1.2.6	Electrical Fast Transient	Normal Operation & No Data Loss	±2kV - Mains	Compliant
EN61000-4-5 VVSG Vol. 1 4.1.2.7	Lightning Surge	Normal Operation & No Data Loss	±2kV Line - Line ±2kV Line - Ground	Compliant

**Table 3-3. Electrical Hardware Test Results (continued)**

Standard/Method	Description	Criteria	Class/Level	Result
EN61000-4-2 VVSG Vol. 1 4.1.2.8	Electrostatic Disruption	Normal Operation & No Data Loss	±8kV Contact ±15kV Air	Compliant
EN61000-4-3 VVSG Vol. 1 4.1.2.10	Electromagnetic Susceptibility	Normal Operation & No Data Loss	10 V/m, 80 MHz – 1 GHz	Compliant
EN61000-4-6 VVSG Vol. 1 4.1.2.11	Conducted RF Immunity	Normal Operation & No Data Loss	10 Vrms, 150 kHz – 80 MHz	Compliant
EN61000-4-8 VVSG Vol. 1 4.1.2.12	Magnetic Immunity	Normal Operation & No Data Loss	30 A/m	Compliant
EN62368-1 UL62368-1 VVSG Vol. 1 4.38	Safety	Normal Operation & No Data Loss		Compliant
Overall Result				Pass /Compliant

The Electrical Supply portion of the Electrical Testing was performed at Pro V&V’s test facility. All components completed the test requirements successfully with no deficiencies noted. Test Result – PASS

Environmental Testing was performed on the components listed above. The procedures and results for this testing are included in NTS Test Report TR-PR121029-01 Revision 1, presented in Attachment A, Part 5 and NTS Test Report TR-PR121029-1 Revision 0, presented in Attachment A, Part 6.

The test results from this testing are summarized in Table 3-4.

**Table 3-4. Environmental Hardware Test Results**

Standard/Method	Description	Criteria	Result
MIL-STD-810D, 516.3, I-3.8 VVSG Vol. 1 4.1.2.14, VVSG Vol. 2 4.6.2	Shock – Bench Handling	Normal Operation & No Data Loss	Pass
MIL-STD-810D, 514.3, I-3.2.1 VVSG Vol. 1 4.1.2.14, VVSG Vol 2 4.6.3	Vibration - Basic Transportation	Normal Operation & No Data Loss	Pass
MIL-STD-810D, 502.2, II-3 VVSG Vol 1 4.1.2.14, VVSG Vol 2 4.6.4	Low Temperature - Storage	Normal Operation & No Data Loss	Pass
MIL-STD-810D, 501.2, I-3.2 VVSG Vol 1 4.1.2.14, VVSG Vol 2 4.6.5	High Temperature - Storage	Normal Operation & No Data Loss	Pass

**Table 3-4. Environmental Hardware Test Results (continued)**

Standard/Method	Description	Criteria	Result
MIL-STD-810D, 507.2, I-3.2 VVSG Vol 1 4.1.2.14, VVSG Vol 2 4.6.5	Humidity – Hot/Humid	Normal Operation & No Data Loss	Pass
MIL-STD-810D, 501.2/502.2 VVSG Vol 1 4.1.2.13, 4.3.3, VVSG Vol 2 4.7.1	Reliability, Temp-Power Variation Testing	Normal Operation & No Data Loss	Pass

**3.2 Anomalies and Resolutions**

When a result is encountered during test performance that deviates from what is standard or expected, a root cause analysis is performed. Pro V&V considers it an anomaly if no root cause can be determined. In instances in which a root cause is established, the results are then considered deficiencies. No anomalies occurred during the testing of the OVS 2.2 System.

**3.3 Deficiencies and Resolutions**

Any violation of the specified requirement or a result is encountered during test performance that deviates from what is standard or expected in which a root cause is established is considered to be a deficiency. Upon occurrence, deficiencies are logged throughout the test campaign for disposition and resolution. All deficiencies encountered during the Unisyn OVS 2.2 test campaign were successfully resolved. In each instance, the resolutions were verified to be resolved through all required means of testing (regression testing, source code review, and TDP update) as needed.

The noted deficiencies are listed in Table 3-5.

**Table 3-5. Noted Deficiencies**

Deficiency #	Description of Deficiency	Resolution
0000503	When Adding Precincts and Split Precincts Ability to Select Split Type in Add Precinct Form was prevented in certain circumstances.	Addressed with updated software release BLM 2.2_R3.
0000504	Precinct and Contests NOT selected by Default When Generating Supplemental Statement of Vote Report.	Tabulator Reports User Guide Release 2.2 Version 1.1 was updated to state that contests are not automatically selected when generating the Supplemental Statement of Votes Report.

**Table 3-5. Noted Deficiencies (continued)**

Deficiency #	Description of Deficiency	Resolution
0000505	Electrical Supply Test for FVT-B Halted due to Printer Disconnecting and Reconnecting then Not Cutting BMD Ballots.	<p>The FVT-B was allowed to electrically discharge the battery, and was then fully recharged. The Electrical Supply Test was run a second time, during which the issue presented itself again. The FVT-B unit was later found to be defective and was replaced with a new FVT-B unit. The Electrical Supply Test was then run using the new unit and completed successfully.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVT_RCA1_BBU.</p>
0000508	Electrical Supply Test for FVT-B Attempt 2 Halted.	<p>The FVT-B unit later found to be defective and was replaced with a new FVT-B unit. The Electrical Supply Test was then run using the new unit and completed successfully.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVT_RCA1_BBU.</p>
0000512	Proportional Rotation prevented from rotating correctly when an Absentee Precinct exists in election.	Addressed with updated software release BLM 2.2_R3.
0000513	Running Eliminate All Option for Ranked Choice Voting against a Multi Seat Contest does not yield expected values.	Tabulator User Guide Release 2.2 Version 1.1 was updated to state that Eliminate All – Continue option, should only be used for tallying Single Seat RCV contests.
0000514	Temperature Power Variation Test Attempt 1 halted for FVS precinct tabulator due to an excessive number of invalid ballot reads.	<p>Issue resolved after the performance of Temperature Power Variation Test Attempt 4.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVS_RCA1.</p>
0000515	Temperature Power Variation Test Attempt 2 halted for FVS precinct tabulator due to an excessive number of invalid ballot reads.	<p>Issue resolved after the performance of Temperature Power Variation Test Attempt 4.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVS_RCA1.</p>

**Table 3-5. Noted Deficiencies (continued)**

Deficiency #	Description of Deficiency	Resolution
0000516	Temperature Power Variation Test Attempt 3 halted for FVS precinct tabulator due to FVS S/N VST100116 being stuck in a state where a ballot jam is present, but clearing the jam did not return the unit to normal operation.	Issue resolved after the performance of Temperature Power Variation Test Attempt 4.  The applicable Root Cause Analysis for this issue is OE2.2_FVS_RCA2.
0000521	Thank You message displayed on FVS unit when casting an Alternate Language Ballot is only partially displayed.	Issue resolved with updated software release FVS 2.2_R7. The default English text displayed beneath the Alternate Language on screen has been adjusted so that the English text is fully visible.
0000522	FVS Does NOT Notify the voter of the consequences of overvoting a contest before the ballot is cast and counted.	Issue resolved with updated software release FVS 2.2_R7. The FVS notifies the voter on screen or in print (depending on configured election options) of the consequences of overvoting a contest, before the ballot is cast and counted.
0000523	OVO Does NOT Notify the voter of the consequences of overvoting a contest before the ballot is cast and counted.	Issue resolved with updated software release OVO 2.2_R7. The OVO notifies the voter on screen or in print (depending on configured election options) of the consequences of overvoting a contest, before the ballot is cast and counted.
0000524	After exporting an election from the Election Manager, some options are not properly greyed out. If such options are modified and the changes are saved, all options are no longer greyed out.	Issue Resolved with updated software release Election Manager 2.2_R6. Once the election is exported all options are properly greyed out and can no longer be modified.
0000525	User was able to Close Polls twice for Election Day session on the FVS. Polls were closed with the Close Ballot at which time the Results Report Printed. The user then accessed the Administrative Menu where they were able to use the Close Polls button to Close the Polls a second time, as the button was not greyed out. The results files were valid and were not affected by closing the polls twice.	Issue resolved with updated software release FVS 2.2_R7. Once the polls are closed with a Close Ballot, the Close Polls functionality in the Administrative Menu is properly greyed out.

**Table 3-5. Noted Deficiencies (continued)**

Deficiency #	Description of Deficiency	Resolution
0000526	FVS Write-In Report is not properly extracting individual write-ins from BMD Ballots and printed individually on the Write-In Report for all ballots. Instead, the default behavior of printing the entire text contents of the BMD ballot was exhibited.	Issue resolved with updated software release FVS 2.2_R7. Individual write-ins detected and extract properly and printed on the Write-In Report.
0000527	In the Ballot Layout Manager application, the preview for a translated (alternate language) ballot measure, does not display the Ballot Measure Title in the selected alternate language.	Issue resolved with updated software release Ballot Layout Manager 2.2_R6. The Ballot Measure Title properly displays in the selected alternate language when previewing the entered text.
0000529	The Full Ballot Review mode on the FVS does not properly display the Measure Responses in an alternate language when casting an alternate language ballot. The Measure Responses are displayed in English only.	Issue resolved with updated software release FVS 2.2_R6. Measure Responses properly display in alternate language in Full Ballot Review mode.
0000530	FVS unit no longer powers on during Functional Configuration Audit.	<p>The FVS S/N VST100151 was returned to Unisyn for analysis and repair. The wires connected to the 12V DC power supply were found to be loose. Once the terminals were tightened power was restored to the unit. Unisyn updated their device manufacturing instructions with updated torque values for the power supply wire connections.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVS_RCA5_FVS_SHUTDOWN.</p>

**Table 3-5. Noted Deficiencies (continued)**

Deficiency #	Description of Deficiency	Resolution
0000531	<p>When closing the polls on an FVS unit during the Volume and Stress Test, the FVS unit displayed Error Code 234 Tally Process Did Not Complete. The Results Report did not print. The user was able to access the Maintenance Menu and print the Results Report. The election results were correct and the election results files were successfully imported into the Tabulator for aggregation and reporting.</p>	<p>Unisyn identified that this error was the result of insufficient memory being allocated during the Close Polls process. A new release of the FVS 2.2_R5 software allocates additional memory to prevent the issue from reoccurring. The Volume and Stress Test was then performed a second time using the updated FVS software.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVS_RCA4_TALLY_234.</p>
0000533	<p>While Performing the Volume and Stress Test Attempt #2, a Cast Ballot was returned to the user with no mention that the ballot had been cast, which was then cast a second time.</p>	<p>Unisyn identified that this issue was the result of a regression error introduced in the FVS 2.2_R6 version of the software. A new release of the software FVS 2.2_R7 addressed the issue. The Volume and Stress Test Attempt #3 was then run, which completed successfully with no errors.</p> <p>The applicable Root Cause Analysis for this issue is OE2.2_FVS_RCA3_BALLOT_RETURN.</p>

**4.0 RECOMMENDATION FOR CERTIFICATION**

The OVS 2.2 Voting System, as presented for testing, successfully met the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Additionally, Pro V&V, Inc. has determined that the OVS 2.2 functioned as a complete system during System Integration Testing. Based on the test findings, Pro V&V recommends the EAC grant the OVS 2.2, as identified in the following tables, certification to the EAC VVSG 1.0.

**Table 4-1. Voting System COTS Hardware**

<b>Hardware</b>	<b>Make</b>	<b>Model</b>
<b>OVO</b>		
<i>Duplex Ballot Scanner</i>		
Duplex Ballot Scanner	PDI Scan	Pagescan III
Scanner Power Adapter	eUrasia Power	uA36-1024
<i>58 mm Thermal Printer</i>		
58 mm Thermal Printer	Citizen Printer	CT-5281
Printer Power Adapter	Citizen Printer	28AD4
<i>Computer</i>		
Chassis	Morex	Morex 2699
DC/DC converter	Morex	MX-0608F
Chassis Fans	Young Lin Tech	DFB404012M
Motherboard	Jetway	JNF9D-2550
Memory	SuperTalent - Onboard RAM	W1333SA2GV
Hard Drive	Western Digital	WD5000AZLX
AC Adapter	EDAC	EA 10951C-120
<i>1 Gb USB TM</i>		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
<i>7" LCD Touchscreen Display</i>		
7" LCD Touchscreen Display	Xenarc Technologies	700TSV
<i>AC Power In Module</i>		
AC Power In Module	Delta	Emi 10BEEG3G
<b>FVS</b>		
<i>Computer</i>		
CPU w/ Fan	Intel	G5400-LGA1151
Motherboard	Jetway	JNC8H-IH310
Memory	Crucial	CT4G48F8824A
SSD 250GB	Crucial	CT250MX500SSD1
<i>80mm Thermal Printer</i>		
80mm Thermal Printer	SNBC	BTS-S80
<i>Duplex Ballot Scanner</i>		
Duplex Ballot Scanner	PDI Scan	Pagescan V
<i>Battery</i>		
Battery	RRC Power Solutions Inc.	RRC2040-2
Power Management Module	RRC Power Solutions Inc.	RRC-PMM240
Power Supply 15VDC AC/DC	Meanwell	UHD-200-15
Power Supply 12/12VDC	Meanwell	RSD-60G-12
Power Supply 12/24VDC	Meanwell	RSD-60G-24
<i>AC Inlet Module</i>		
AC Inlet Module	Schurter	4303.5013
<i>Fuse Drawer 1P</i>		
Fuse Drawer 1P	Schurter	4303.2406
<i>Switch On/Off DPDT</i>		
Switch On/Off DPDT	Switchcraft	EHRRLBPKG

**Table 4-1. Voting System COTS Hardware (continued)**

<b>Hardware</b>	<b>Make</b>	<b>Model</b>
<i>1 Gb USB TM</i>		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
<b>OVI-VC</b>		
<i>Sip and Puff (Optional)</i>		
Sip and Puff (Optional)	Origin Instruments	AirVoter
<i>Headphone (Optional)</i>		
Headphone (Optional)	Koss On-Ear Headphones	KPH5
<i>15 in LCD Touchscreen Display</i>		
15 in LCD Touchscreen Display	GVision	P15BX-OB-4690
<i>82.5 mm Thermal Printer</i>		
82.5 mm Thermal Printer	Star	TSP743IID-24, serial interface
Printer Adapter	Star	PS60A-24B 1
<i>Computer</i>		
Power Adapter Kit	DC-DC Converter	MX-0608F
Motherboard	Jetway	JNF9D-2550
Hard Drive	Western Digital	WD5000AZLX
Adapter	EDAC	EA 10951c-120
<i>1 Gb USB TM</i>		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
<i>AC Power In Module</i>		
AC Power In Module	Delta	Emi 10BEEG3G
<b>OVCS</b>		
<i>Large Volume Scanner</i>		
Large Volume Scanner	Canon	DR-X10C DR-G2140
<i>Desktop Scanner</i>		
Desktop Scanner	Canon	DR-M160II
<i>Laptop</i>		
Laptop	Dell	Dell Precision
<i>Desktop PC</i>		
Desktop PC	Dell	Dell Optiplex
<b>FVT</b>		
<i>13.3 in Touchscreen Tablet</i>		
13.3 in Touchscreen Tablet	Android Tablet	GVision - T13
Tablets Battery Charger	Sager Power System	GC30B-4P1J
<i>82.5 mm Thermal Printer</i>		
82.5 mm Thermal Printer	Star	TSP743IIU-24
Printer Adapter	Star	PS60A-24B 1
<i>Barcode Reader 1D,2D series</i>		
Barcode Reader 1D,2D series	Newland	FM420 & FM430

**Table 4-1. Voting System COTS Hardware (continued)**

<b>Hardware</b>	<b>Make</b>	<b>Model</b>
<i>USB Hub</i>		
USB Hub	D-Link	DUB-H4
Hub Adapter	Meanwell	PSD-15A-05
<i>1 Gb USB TM</i>		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
<i>Micro SD</i>		
Micro SD	San Disk	4 GB Edge
<i>AC Power In Module</i>		
AC Power In Module	Delta	Emi 10BEEG3G
<i>Sip and Puff (Optional)</i>		
Sip and Puff	Origin Instruments	AirVoter
<i>Headphone (Optional)</i>		
Headphone	Koss On-Ear Headphones	KPH7
<i>USB to Ethernet RJ45 Adapter (Optional)</i>		
USB to Ethernet RJ45 Adapter	D-Link	DUB-E100
<b>FVT-B</b> <b>(Includes items listed for the FVT above)</b>		
<b>Battery</b>		
Battery	RRC Power Solutions Inc.	RRC2040-2
Power Management Module	RRC Power Solutions Inc.	RRC-PMM240
Power Supply 15VDC AC/DC	Meanwell	UHD-200-15
Power Supply 12/12VDC	Meanwell	RSD-60G-12
Power Supply 12/24VDC	Meanwell	RSD-60G-24
<b>UPS</b>		
UPS System – Minuteman Power Technologies	Para Systems, Inc.	Entrepid Series EP1500 LCD
Surgecube – Surge Protector	Belkin	F9H100-CW

**Table 4-2. OVCS System COTS Software Components**

<b>OVS Hardware</b>	<b>Version</b>
Desktop for non-redundant solutions	Dell OptiPlex 360, 755, 7010, D075/XE2
Desktop for redundant solutions	Dell Precision T3500, T3600, T5810, T5820, 3420
Canon Scanner (OVCS)	Canon DR-X10C or DR-M160II
Laptop	Dell Latitude E5500, E5540, E5570, E5590, E5500 v2, Dell XPS m1530, HP 2000

**Table 4-3. OVS 2.2 COTS Software Components**

<b>FVT, FVS, OVO and OVI-VC Device Software</b>	<b>Version</b>
<b>Cent OS Linux</b>	
OVO1 and OVI-VC1	5.0
OVO2 and OVI-VC2	6.3
FVS	8.0
<b>Java JRE + Unlimited Cryptographic Extension</b>	
OVO and OVI-VC	1.6.0_02
FVS	1.6.0_45
<b>Android OS</b>	
FVT	4.4.4

**Table 4-4. OCS and OVCS COTS Software Components**

<b>OCS and OVCS Device Software</b>	<b>Version</b>
CentOS Linux	6.5, 6.8 and 7.6
Java JRE + Unlimited Cryptographic Extension	1.6.0_02
Apache-Tomcat Application Server	6.0.13
MySQL Database (BLM, EM, AUD, and Tab only)	5.0.45-7, 5.7 (on CentOS 7.6)
JasperReports	2.0.5
OpenSSL	1.0.1f-fips
OpenVPN	2.4.4

**ATTACHMENT A**

**Hardware Test Reports**

*Attachments A-1 through A-6 are provided under separate cover.*